

REMARKS

This response addresses the issues raised by the Examiner in the Office Action mailed December 1, 2004. Initially, Applicants would like to thank the Examiner for the careful consideration given in this case. The Claims were 1-3 and 6-14. Claims 2-3, 7-10 and 13-14 have been currently amended and Claims 1 and 6 have been canceled. New Claim 15 has been added. Thus, Claims 2-3 and 7-15 are pending in this case all to more clearly and distinctly claim Applicants' invention. Applicants respectfully request entry of the amendments as they place the application in condition for allowance or in better condition for possible appeal.

New Claim 15 has been added to incorporate the language of previous Claims 1 and 6. More specifically, Claim 15 claims a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration (CVI) with methyltrichlorosilane (MTS) in hydrogen (H₂) on fiber scrims of carbon fiber preforms or silicon carbide fiber preforms, wherein the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8. The process of the present invention further comprises adjusting the process pressure to ≥ 0.6 bar absolute, adjusting the process temperature to $\geq 1100^{\circ}\text{C}$ and arranging a heat-resistant material with a large surface between a gas feed in the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas. Support is found in the specification and claims as originally filed. No new matter has been added.

Rejection Based On 35 U.S.C. § 112, First Paragraph

The Examiner rejects Claims 1-14 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The Examiner argues that the claims contain subject matter that was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. More specifically, the Examiner asserts that the specification does not have adequate support for the claimed process temperature being greater than 1000 degrees Celsius. Applicants respectfully traverse this rejection.

Solely to advance prosecution of this application, Applicants have canceled independent Claims 1 and 6, in which Claims 2-3 and 7-14 depend. Applicants have also added new independent Claim 15 which incorporates the language of previous Claims 1 and 6. Claims 2-3

and 7-14 have been currently amended to depend on new Claim 15. Accordingly, Applicant will address this rejection as applied to Claim 15. As stated above, Claim 15 discloses a process for producing a high temperature stable fiber composite by chemical infiltration with a methyltrichlorosilane (MTS) in hydrogen (H_2) on fiber scrims of carbon fiber preforms or silicon carbide fiber preforms, wherein the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8, the process further comprises adjusting the process pressure to ≥ 0.6 bar absolute, adjusting the process temperature to $\geq 1100^\circ C$ and arranging a heat-resistant material with a large surface between a gas feed in the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas. Here, the process temperature includes $1100^\circ C$ or greater to address the concerns of the Examiner. Support for this may be found, for example, in the specification at page 4, lines 3-5. Therefore, this rejection is rendered moot. Withdrawal of the present rejection is respectfully requested.

Rejection Based On Huttinger Under 35 U.S.C. § 103 (a)

The Examiner rejects Claims 1-3, 6-9, 13 and 14 under 35 U.S.C. § 103 (a) as being unpatentable over WO 98/21163 to Huttinger et al. ("Huttinger"), as applied to new Claim 15. Applicants respectfully traverse this rejection.

The Examiner argues that Huttinger teaches a CVI process for depositing SiC into a preform. While the Examiner concedes that Huttinger fails to teach a process temperature of greater than $1100^\circ C$, the Examiner argues that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to use temperatures with the Applicants' range in the process taught by Huttinger. Further, the Examiner states that differences in temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration of temperature is critical. Thus, the Examiner concludes that Applicants have not shown the criticality between $1100^\circ C$ and $1100.01^\circ C$.

To establish obviousness of a claimed invention, all claim elements must be disclosed, taught or suggested by the prior art. As stated above, Claim 15 discloses a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration with a methyltrichlorosilane in hydrogen on fiber scrims of carbon fiber preforms or silicon carbide

preforms, wherein the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8, the process further comprises adjusting the process pressure to ≥ 0.6 bar absolute, adjusting the process temperature to $\geq 1100^{\circ}\text{C}$ and arranging a heat-resistant material with a large surface between a gas feed in the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas. Here, the process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration includes adjusting the process temperature to greater than or equal to 1100°C .

Applicants respectfully submit that according to the prior art, the claimed temperature range is critical. This is because the prior art shows that it is impossible to carry out an infiltration with silicon carbide (SiC) successfully. Also, for example, a temperature increase of 50°C from 1100°C to 1150°C has a considerable effect on the reaction and deposition rate so that under prior art process conditions the infiltration of fiber preforms were impossible. Moreover, Examples 1 to 3 of the present invention mention temperatures of 1100°C , 1150°C and 1200°C , respectively and thus clearly cover the claimed temperature range of the present invention. Temperatures at or close to 1100°C are chosen in case fibers are used which may suffer from thermal degradation, e.g. amorphous SiC fibers.

We agree with the Examiner that Huttinger does not teach a process temperature of greater than 1100°C . Huttinger teaches a method for chemical vapor infiltration of carbon and silicon carbide based on diffusion in a porous structure and functions isothermally. See Abstract and Specification at Col. 2 and 3, lines 65-68 and lines 1-2, respectively. In addition, Huttinger controls the deposition process by influencing the saturation concentration of the solid forming gas species on the substrate surface. See Col. 3, lines 4-19. In the case of the deposition of SiC, this occurs by adding hydrogen chloride to the starting process gas. See Col. 8, lines 31-32. Hydrogen chloride hinders the adsorption on the substrate surface of gas species resulting in the formation of SiC.

In contrast, the present invention controls the deposition process by conditioning the process gas (methyltrichlorosilane and hydrogen) by means of a thermally induced pre-reaction of this process gas fed into the reaction chamber at a heat-resistant material arranged between

the gas inlet and the fiber preform to be infiltrated. Such a teaching is not disclosed by Huttinger with the claimed pressure and temperature ranges.

The Examiner states that Figure 4 teaches the preconditioning step of the present invention. However, the device in Huttinger excludes any pre-reaction of the gas. This is because Figure 4 shows a cone-shaped body in the gas inlet made from solid ceramic. See Col. 13, lines 25-26. Solid ceramic is made of dense material, i.e. with a low surface area. The purpose of this arrangement is to direct the process gas as quickly as possible and without heating and thus without reaction to the body to be infiltrated by forming a narrow gap to the reactor wall.

In contrast, the present invention provides preconditioning the process gas to allow a uniform deposition over a large reaction space at a higher temperature and with an increased deposition rate. In support, the specification on page 5, lines 18-26 states the following: "it has turned out that process gas that has not been pre-reacted causes a rapid deposition on the outer surfaces of the fiber scrim and accordingly causes a sealing of its access pores. The reason for this is the presence of thermally unstable molecular species, primarily products with a high silicon content, which form immediately after the still cool process gas enters the reaction space and which have only a short life span at the process temperature. These molecular species react on the large-surface heat-resistant material. Only molecular species with a long life reach the fiber scrim to be infiltrated and enable the deposition of silicon carbide deep into the fiber scrim."

Unlike the present invention, Huttinger requires that the preform (substrate) not be directly contacted by the process gas and that the small gap between the geometric surface of the preform and the reactor wall has to be adjusted, this process does not allow for the production of complicated structures like those of a control flap.

Moreover, Huttinger uses a completely different substrate, namely an aluminum oxide substrate of an open porosity of only 23.24 %. See Col. 13, line 42. However, the present invention is concerned with the production of fiber-reinforced ceramics and thus starts from ceramic or carbon fiber as a substrate, where the fiber content is about 42 to 44 vol. %. See page 6, lines 1-8. This corresponds to an open porosity of more than 56 vol. %. Accordingly, the

6, lines 1-8. This corresponds to an open porosity of more than 56 vol. %. Accordingly, the form and distribution of porosity in the substrates of Huttinger and that of the present invention are completely different.

Since the process parameters, methods and products of the present invention are different from the teaching of Huttinger, Huttinger does not teach the present invention. For persons skilled in the art, it is a surprising result that by the process design with preconditioning of the process gas in combination with the chosen physical and chemical parameter compared with the state of the art is significantly faster infiltration with high quality of the form composite ceramic is achieved by the present invention. Furthermore, Huttinger does not teach the process temperature of greater than 1100 °C. Thus, the Applicants believe that the present invention is not obvious over the teaching of Huttinger since Huttinger does not teach, disclose or suggest the present claims. Therefore, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103 (a).

Rejection Based On Huttinger In View of Murphy Under 35 U.S.C. § 103 (a)

The Examiner rejects Claims 10-12 under 35 U.S.C. § 103 (a) as being unpatentable over WO 98/21163 to Huttinger et al. ("Huttinger") and further in view of U.S. Patent No. 4,407,885 to Murphy et al. ("Murphy"), as applied to new Claim 15. Applicants respectfully traverse this rejection.

The Examiner acknowledges that Huttinger does not teach how the preform is made. Instead, the Examiner cites to Murphy for teaching a method of forming preforms. Thus, the Examiner concludes that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to use the method taught by Murphy to construct the preforms in the process taught by Huttinger and have a reasonable expectation of success.

Applicants respectfully disagree with the Examiner. To establish obviousness of a claimed invention, all claim elements must be disclosed, taught or suggested by the prior art. As stated above, Claim 15 includes a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration with methyltrichlorosilane in hydrogen on fiber scrims of carbon fiber preforms or silicon carbide fiber preforms, wherein the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8, the process

further comprises: adjusting the process pressure to ≥ 0.6 bar absolute; adjusting the process temperature to $\geq 1100^{\circ}\text{C}$; and arranging a heat-resistant material with a large surface between a gas feed in the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas.

Applicants agree with the Examiner that Huttinger does not teach how the preform is made. Also, as stated above, Huttinger does not teach the process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration further comprising adjusting the process pressure ≥ 0.6 bar absolute, adjusting the process temperature to $\geq 1100^{\circ}\text{C}$ and arranging a heat-resistant material with a large surface between a gas feed in the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas. Further, Huttinger does not teach using the process temperature that is greater than 1100°C

Although Murphy discloses a method of making a composite fabric preform, Murphy does not cure these deficiencies of Huttinger. Thus, Applicants believe that the amended invention is not obvious over the teaching of Huttinger further in view of Murphy since Huttinger and/or Murphy does not teach, disclose or suggest the present claims. Moreover, one skilled in the art would find nothing in Huttinger or Murphy alone or in combination that would disclose, teach or suggest the claimed invention or any reason for making it. Further, there is no motivation to combine the references in such a way to get the claimed invention. Therefore, an obvious rejection under 35 U.S.C. §103 (a) is improper.

Rejection Based On Huttinger In View of Linn Under 35 U.S.C. § 103 (a)

The Examiner rejects Claims 1-3, 6-9, 13 and 14 under 35 U.S.C. § 103 (a) as being unpatentable over WO 98/21163 to Huttinger et al. ("Huttinger") in view of U.S. Patent No. U.S. 6,143,376 to Linn et al ("Linn"), as applied to Claim 15. Applicants respectfully traverse this rejection.

The Examiner acknowledges that Huttinger does not teach a process temperature of greater than 1100°C . Instead, the Examiner asserts that Linn discloses using 1200°C as the process temperature. Thus, the Examiner concludes that it would have been obvious at the time

the invention was made to a person of ordinary skill in the art to utilize 1200 °C as the process temperature in Huttinger and have a reasonable expectation of success.

Applicant respectfully disagrees with the Examiner. To establish obviousness of a claimed invention, all claim elements must be disclosed, taught or suggested by the prior art. The present invention claims a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration with methyltrichlorosilane in hydrogen on fiber scrims of carbon fiber preforms or silicon carbide fiber preforms, wherein the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8, the process further comprises: adjusting the process pressure to ≥ 0.6 bar absolute; adjusting the process temperature to $\geq 1100^{\circ}\text{C}$; and arranging a heat-resistant material with a large surface between a gas feed in the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas.

Applicants agree with the Examiner that Huttinger does not teach a process temperature of greater than 1100 °C. In addition, Huttinger does not teach the process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration further comprising adjusting the process pressure ≥ 0.6 bar absolute, adjusting the process temperature to $\geq 1100^{\circ}\text{C}$ and arranging a heat-resistant material with a large surface between a gas feed in the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas.

Linn teaches a method for coating individualized short fibers with freely accessible surfaces. However, Linn does not cure the deficiencies of Huttinger. Thus, Applicants believe that the amended invention is not obvious over the teaching of Huttinger further in view of Linn since Huttinger and/or Linn does not teach, disclose or suggest the present claims. Moreover, one skilled in the art would find nothing in Huttinger or Linn alone or in combination that would disclose, teach or suggest the claimed invention or any reason for making it. Further, there is no motivation to combine the references in such a way to get the claimed invention. Therefore, an obvious rejection under 35 U.S.C. §103 (a) is improper.

Rejection Based On Huttinger In View of Linn And Further In View of Murphy Under 35 U.S.C. § 103 (a)

The Examiner rejects Claims 10-12 under 35 U.S.C. § 103 (a) as being unpatentable over WO 98/21163 to Huttinger et al. ("Huttinger") in view of U.S. Patent No. U.S. 6,143,376 to Linn et al. ("Linn"), as applied to Claim 1 above and further in view of U.S. Patent No. 4,407,885 to Murphy et al. ("Murphy"), as applied to new Claim 15. Applicants respectfully traverse this rejection.

The Examiner concedes that Huttinger in view of Linn is silent in teaching how the preform is made. Instead, the Examiner asserts that Murphy teaches a method of forming preforms that read of Applicants' method. Thus, the Examiner concludes that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to use the method of Murphy to construct the preforms in the process taught by Huttinger in view of Linn and have a reasonable expectation of success.

Applicant respectfully disagrees with the Examiner. To establish obviousness of a claimed invention, all claim elements must be disclosed, taught or suggested by the prior art. The present invention claims a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration with methyltrichlorosilane in hydrogen on fiber scrims of carbon fiber preforms or silicon carbide fiber preforms, wherein the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8, the process further comprises: adjusting the process pressure to ≥ 0.6 bar absolute; adjusting the process temperature to $\geq 1100^{\circ}\text{C}$; and arranging a heat-resistant material with a large surface between a gas feed in the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas.

Applicants agree with the Examiner that Huttinger and Linn do not teach how the preforms are made. In addition, Huttinger and Linn do not teach the process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration further comprising adjusting the process pressure ≥ 0.6 bar absolute, adjusting the process temperature to $\geq 1100^{\circ}\text{C}$ and arranging a heat-resistant material with a large surface between a gas feed in

the reaction space and between the fiber scrims of carbon fiber preforms or silicon carbide fiber preforms to be infiltrated for preconditioning the process gas.

Although Murphy discloses a method of making a composite fabric preform, Murphy does not cure the deficiencies of Huttinger. Thus, Applicants believe that the amended invention is not obvious over the teaching of Huttinger in view of Linn and further in view of Murphy since Huttinger, Linn and/or Murphy does not teach, disclose or suggest the present claims. Moreover, one skilled in the art would find nothing in Huttinger, Linn or Murphy alone or in combination that would disclose, teach or suggest the claimed invention or any reason for making it. Further, there is no motivation to combine the references in such a way to get the claimed invention. Therefore, an obvious rejection under 35 U.S.C. §103 (a) is improper.

In view of the remarks presented herein, it is respectfully submitted that the present application is in condition for final allowance and notice to such effect is requested. If the Examiner believes that additional issues need to be resolved before this application can be passed to issue, the undersigned invites the Examiner to contact him at the telephone number provided below.

Respectfully submitted,

Dated: February 28, 2005

By 
Gerald H. Kiel
Reg. No. 25,116
REED SMITH LLP
599 Lexington Avenue
29th Floor
New York, NY 10022-7650
(212) 521-5400
Attorney for Applicant

GHK:ST/vh